Transport Canada Transports Canada

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Marine Casualty Investigations

Enquêtes sur les accidents maritimes

Investigation Report to the Minister pursuant to sections 477 or 480 of the Canada Shipping Act (1985)

Rapport d'investigation au Ministre conformément aux articles 477 ou 480 de la Loi sur la marine marchande du Canada (1985)

Canada

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Ce rapport est aussi disponible en français

REPORT OF THE INVESTIGATION INTO THE LOADING AND DEPARTURE CONDITION FROM MONTREAL OF THE CYPRIOT VESSEL "CHARLIE", WHICH SUBSEQUENTLY DISAPPEARED AND IS PRESUMED SUNK IN THE NORTH ATLANTIC ON OR ABOUT JANUARY 20, 1990.

REPORT No. 554

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This report and its contents may be deficient and misleading if used in any other process and are not to be used or admitted in evidence in any legal proceedings, either civil or criminal, arising out of the casualty described in the report. The statements, opinions and findings in the report are those of the Marine Casualty Investigations Division only and do not constitute admissions made by or on behalf of Her Majesty the Queen in right of Canada.

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Effective March 29, 1990, the mandate to conduct investigations into Marine Occurrences was transferred to the Transportation Safety Board of Canada (TSB) - Investigations Marine. In accordance with the Act establishing this new organization, outstanding investigations conducted under the Canada Shipping Act prior to this date are being completed and distributed by TSB - Investigations Marine.

Dupuis le 29 mars 1990, le Bureau canadien de la sécurité des transports (BST) - Enquêtes - Maritimes, a reçu le mandat de mener les enquêtes sur les accidents maritimes. Conformément à loi créant ce nouveau Bureau, les enquêtes en cours prévues par la Loi sur la marine marchande seront terminés et les rapports distribués par le BST - Enquêtes Maritimes.

REPORT OF THE INVESTIGATION INTO THE LOADING AND DEPARTURE CONDITION FROM MONTREAL OF THE CYPRIOT VESSEL "CHARLIE", WHICH SUBSEQUENTLY DISAPPEARED AND IS PRESUMED SUNK IN THE NORTH ATLANTIC ON OR ABOUT JANUARY 20, 1990

PARTICULARS OF THE VESSEL

Name	"CHARLIE", ex "HAPPY VALLEY", ex "WASHU"
Official No.	707850
Flag	Cypriot
Port of Registry	Limassol
Call Sign	C4MR
Gross tonnage	10,673.58
Net tonnage	5,495.14
Length B.P.	148.00 m
Breadth Mld.	23.40 m
Depth Mld.	13.00 m
Draughts (Fresh Water, on departure Montreal)	forward: 9.70 m midships: 9.55 m aft: 9.50 m
Type	Bulk Carrier
Built	of steel in Japan in 1975, Kanawa Dockyard, Hiroshima, Japan
Propulsion	One 7,356 KW oil engine driving a single fixed-pitch propeller
Speed	Maximum service 16.5 kn, according to the Certificate of Registry
Cargo	18,500 mt of No.3 CWRS wheat and 28 mt of baled empty grain bags and rolls of string
Crew	27 persons, including the master
Classification	Nippon Kaiji Kyokai (NK)
Owner	Acari Shipping Co. Ltd., Limassol, Cyprus
Managers	Transmed Shipping Ltd., Kiffissia, Attiki, Greece.

Charterer	Canadian Maritime Carriers Ltd., North York, Ont.
Owners' Agent	McLean Kennedy Inc., Montreal, PQ.
Vessel's Agent	Lillis Marine Agencies Ltd., Montreal, PQ.

Crew List

Name	Rank	Date of Birth
Krasowski, Marek	Master	08-12-54
Pepito, Manolito M.	First Mate	19-09-54
Alanano, Antonieto E.	Second Mate	13-11-59
Cubero, Gerry C.	Third Mate	21-07-60
Celestra, Celso L.	Radio Operator	04-03-54
Culpa, Sulpicio A.	Chief Engineer	17-01-34
Cardino, Alejandro C.	Second Engineer	09-02-40
Tumamak, Joel G.	Fourth Engineer	11-06-54
Cruz, Manuel N.	Fourth Engineer	13-01-61
Ortigoza, Arthur S.	Electrician	25-06-61
Ocfemia, Leopoldo C.	Fitter	15-11-57
Ortiz, Manuel R.	Bo'sun	26-03-60
Terunez, Jay T.	A. B.	08-01-60
Pura, Salvador A.	A. B.	22-06-60
Fernandez, Marianito C.	A. B.	12-05-64
Aviles, Charlie B.	O. S.	12-01-65
Gallardo, Rocelito A.	O. S.	30-08-67
Martinez, Vicente M.	Cadet	20-04-62
Aquino, Alex G.	Oiler	18-07-64
Tarroza, Alfredo V.	Oiler	09-08-62
Monteclaro, Bernie M.	Oiler	26-11-61
Solajes, Yul Thadeus M.	Cabin Boy	26-01-62
De Leon, Melvin E.	Cabin Boy	13-11-62
Adlawan, Rodulfo M.	Cadet	29-10-61
Tordil, Noel R.	Cadet	09-07-66
Banua, Teofisto J.	Cadet	20-09-60
Culpa, Flora A.	Guest	06-07-41

All crew members listed in the crew list were of Philippine nationality, except for the master, who was of Polish nationality.

NOTES: - In this report, all times are expressed in Eastern Standard Time (U.T.C. minus 5 hours) unless otherwise indicated.

- This casualty, which occurred in international waters and involved a ship of Cypriot registry, was investigated pursuant to Part VI of the Canada Shipping Act, Sections 476(f) and 480(1).

- In accordance with Part C, Regulation 21(Casualties) of the International Convention for the Safety of Life at Sea (SOLAS) 1974, the 1978 Protocol and the 1981 and 1983 SOLAS amendments, it is the responsibility of the flag state to conduct investigations into casualties.

- In order to provide safety related information to Canadian Authorities, this report is therefore limited primarily to questions concerning the loading of the vessel "CHARLIE" in Canada and to her condition upon sailing from Canada.

Brief description of the vessel

The "CHARLIE", was a single deck bulk dry cargo carrier of all welded steel construction, with propelling machinery, navigating bridge and crew accommodation aft, and forward, four cargo holds each served by a single hatchway and 25t S.W.L. derrick. Port and starboard topside tanks in way of the three foremost holds were arranged for the carriage of water ballast, while those in way of hold No.4 were for oil fuel. The fore and after peaks and combined bottom and side tanks in way of all four holds were also arranged for the carriage of water ballast, while centre double bottom tanks in way of holds No. 2, No. 3 and No. 4 were for oil fuel.

Narrative

The Cypriot vessel departed Nantes, France in ballast on December 13, 1989 for Montreal to load a cargo of wheat. This cargo was for Port Sudan, Sudan and for two ports in Mozambique, Nacala and Maputo.

After a rough crossing of the Atlantic due to bad weather, the "CHARLIE" arrived at the Port of Quebec at about 1600 on January 4, where she was to pass the night before continuing her voyage to Montreal. As the vessel had suffered some superstructure and deck fittings damage, and also ice damage to her propeller, she was visited by a Ship Safety Inspector of the Canadian Coast Guard, who required that the propeller be repaired before the vessel continued her voyage to Montreal.

At about 1500 on Saturday, January 6, 1990, Ship Safety gave the vessel authorization to proceed, the repairs to the

propeller having been completed to the satisfaction of NK. In order to ensure sufficient immersion and prevent further ice damage to the propeller, all the topside and double-bottom ballast tanks and peak tanks were ballasted before leaving Quebec.

Because of restrictions on night navigation between Quebec and Montreal, the "CHARLIE" was scheduled to sail the following morning, January 7, 1990. However, due to poor visibility on that day, her departure was delayed a second time until January 8, 1990.

On January 8, the "CHARLIE" left Quebec upbound for Montreal, where she arrived at berth No. 54 (grain elevator No. 4) at about 1345 on January 9, 1990.

A pre-loading stability calculation for an intended load of 18,700 mt of bulk grain, completed for the "CHARLIE" by her master, was submitted to the deputy port warden. After visiting the vessel during the afternoon of January 9, 1990 and accepting the pre-loading calculation of stability, the deputy port warden issued a certificate of readiness to load at about 1530. Note was made on this document that one of the two proposed partially filled holds might require cargo strapping, depending on the actual stowage factor.

Loading began on the afternoon of January 10, and while loading was in progress, the stowage factor was estimated to be 1.275 m^3 per metric tonne, compared to the figure of 1.246 m^3 per metric tonne used in the pre-loading calculation of stability.

During the day of January 11, 1990, loading was halted due to difficulties in deballasting.

It was noted that the vessel had a marked forward trim and was heeled to port. Due to mechanical damage to the suction valve control linkage reportedly incurred while the vessel was in Quebec, the fore peak tank could not be deballasted by the ship's pumps and a portable shoreside pump was utilised. According to a detailed post-casualty report prepared by the ship's managers shore-based engineer superintendent, who was on board at the time, deballasting of No. 1 & No. 2 double bottom tanks was subsequently completed as the forward trim was reduced and the suctions at their after ends become operable. However, steam clearing was not employed and some frozen fresh water ballast in the topside wing tanks and fore peak tank was not discharged.

Loading of the "CHARLIE" recommenced during the afternoon of January 13, 1990 and was completed that evening. A mechanical

trimmer to facilitate hold end trimming was available at the wharf throughout the loading period, but it was not employed.

At about 2130 on January 13, the port warden gave verbal authorization for the vessel to sail. When she left berth No. 54 for the bunkering berth No. 103, her draughts, as recorded on the cargo plan, were 10.02 m forward, 9.56 m midships and 9.30 m aft.

At berth No. 103, the "CHARLIE" bunkered 250 mt of heavy oil IFO 180CST. She left Montreal on the morning of January 14 at about 0700 with a destination of Ceuta, Spain, for bunkers and then for Port Sudan in the Red Sea, her first unloading port. Upon leaving Montreal, in hold No. 1 she carried 4,263 mt of No.3 CWRS wheat and 158 bales of empty grain bags on top of the unsecured grain surface, as well as 15 rolls of twine for a total of 19 mt. Hold No. 2 was loaded with some 5,489 mt, and hold No. 4 was likewise loaded with 5,248 mt. However, hold No. 3 contained only about 3,500 mt of No. 3 CWRS wheat, together with 72 bales of empty grain bags and 7 rolls of twine totalling 9 mt, on top of the levelled and unsecured grain surface.

At about 1725 on January 14, the "CHARLIE" was off Quebec and, after changing pilots, she continued toward the pilot station at Les Escoumins.

Previously on January 11, 1990, while the "CHARLIE" was in the port of Montreal, the charterer gave the master his voyage instructions. Among other things, these instructions informed the master that if he so desired he could obtain information on weather conditions and optimal routes from OCEANROUTES of New York. If he did not choose to follow their recommendations, he was to continue to report his position to them at noon each day. Also, every other day he was to send a message to SHIPTRADE in Toronto, giving his position at noon and other information.

The first message from the "CHARLIE" to SHIPTRADE of Toronto was sent on January 14, 1990, and others were sent on January 16 and 18, 1990. The last message read as follows:

"181500Z 45° 54′ North, 49° 24′ West, cons. 48.6/4 46 hours 583 NM ROB 291.3/65.5 12.7 kts SSW 7 rough sea ETA CEUTA 25th/wp RGDS "CHARLIE".

Deciphered this means:

"January 18, 1500 UTC 45°54′N 49°24′W, consumption 48.6 tons fuel oil 4.0 tons diesel during the last 46 hours and during this time the vessel has steamed 583 nautical miles. Remaining on board 291.3 tons fuel oil and 65.5

tons diesel. Current conditions are wind SSW Force 7 (28 to 33 knots) with rough sea, vessel's speed 12.7 knots. ETA Ceuta January 25, weather permitting. Regards. CHARLIE."

Then, during the afternoon of January 18, 1990, SHIPTRADE of Toronto sent a message to the "CHARLIE", asking her when she had last transitted the Suez Canal, and under what name. No response was received to this inquiry.

According to OCEANROUTES of New York, the message sent by the "CHARLIE" on January 18, 1990 was the last one they received from her. In that message, the "CHARLIE" advised OCEANROUTES that her course was 091° (T) and her speed was 12.6 kn, giving an estimated date of arrival at Ceuta of January 25, 1990.

Nevertheless, it appears that the last message from the "CHARLIE" was sent to AMVER via Halifax radio on January 19, 1990 at about 1410 U.T.C., which read as follows:

"AMVER / PR
A / CHARLIE / C4MR
B / 191200Z / 45° 37′ N / 043° 03′ W
I / CEUTA / 33° 54′ N / 005° 19′ W / 25 PM"

The last visual and VHF radio contact with the "CHARLIE" took place on January 19, 1990 at about 2210 local time, i.e. at 0210 U.T.C. on January 20, with the Italian tanker "CHIPPEWA". The "CHIPPEWA" was sailing for Montreal on a course of 250° (G) when she detected a radar echo ahead to starboard. According to information obtained from the ARPA radar, this echo, which was soon to be identified as that of the "CHARLIE", was heading 120° (T) at a speed of between 7 and 8 kn. The master of the "CHIPPEWA" went up to the bridge, and his third mate told him of the presence of a vessel to starboard ahead. While the master was on the bridge, there was a VHF radio call on channel 16 from the "CHARLIE". The two vessels identified themselves, and the "CHARLIE" gave her destination to the "CHIPPEWA". They discussed a number of things, including the ice conditions on the St. Lawrence River. During this communication, the "CHARLIE" asked the "CHIPPEWA" if she had a Sat Nav. As the "CHIPPEWA" did have a Sat Nav, she fixed the "CHARLIE"'s position as 45° 30′ N latitude and 40° 06′ W longitude. There was no indication during this radio communication, which lasted about 3 minutes, that the "CHARLIE" was having difficulties of any kind.

At about 2200 local time on January 19, the following note was written in the log of the "CHIPPEWA":

'...Poor visibility - violent storm, phenomenal sea - heavy rolling and pitching - seas on deck. M.E. reduced for handling adverse weather.'

At 2200, according to the log of the "CHIPPEWA", the winds were SW force 11, the barometric pressure was 1,000 mbs, the air temperature was 8°C and the sea temperature was 12°C. The vessel was steering 250° by gyro-compass to make good a course of 267° (T).

According to the navigating personnel aboard the "CHIPPEWA", the "CHARLIE" had passed at a distance of 8 M on the starboard side. They saw her navigation lights burning normally.

According to the master of the "CHIPPEWA", the strongest and highest swell came from the southwest, and another weaker swell came from the west. The seas were estimated to be 10 m.

The next day, January 20, 1990, neither SHIPTRADE, OCEANROUTES nor AMVER received any message from the "CHARLIE". The charterer had not heard from the "CHARLIE" either, and he waited until Monday, January 22, 1990 to communicate with the owners. The owners confirmed that the last contact with the "CHARLIE" had taken place on January 18, 1990, and that since that time, efforts had been made to contact her, but without success.

During this period the owners checked with several marine radio stations, but none of them had been in contact with the "CHARLIE". Consequently, on January 24, 1990 the owners decided to report to the Canadian, American and Portuguese Coast Guards that the vessel was missing, and to seek their assistance in locating her.

Despite a vast search of the Atlantic Ocean, the Cypriot vessel "CHARLIE" with her crew of 27 was never located nor was any debris identified. She was declared missing and presumed to have sunk.

Analysis

1. Chartering of the "CHARLIE"

On her departure from Nantes, France on December 13, 1989, the "CHARLIE" had been chartered by Canadian Maritime Carriers to load a cargo of wheat in Montreal for discharge in Maputo and Nacala, Mozambique. Initially, the charter party

indicated a cargo of 12,800 mt of bulk wheat for Maputo and 2,200 mt for the port of Nacala, with +/- 5% at the charterer's option. Also, the charter party indicated 31.5 mt of baled empty grain bags and rolls of string to be used for bagging the wheat at the unloading port.This cargo of wheat was shipped by the Canadian International Development Agency (CIDA).

However, while the "CHARLIE" was in the Port of Quebec for repairs, an addendum was made to the charter party dated January 5, 1990, which modified the voyage of the "CHARLIE", adding 3,500 mt of wheat to be unloaded in Port Sudan. Loading this cargo, shipped by the Canadian Food Bank of Winnipeg, altered the sequence of unloading ports. The cargo of 3,500 mt for Port Sudan had to be stowed in such a way as to keep it separate from the cargo destined for the ports in Mozambique.

As a result of these changes, the charterer modified the voyage instructions for the "CHARLIE". Initially, the vessel was to head for Mozambique via the Cape of Good Hope in South Africa. The itinerary was modified, adding a stop in Ceuta, Spain to bunker fuel and then via the Suez Canal for Port Sudan as her first port of call.

The segregation of 3,500 mt of wheat in a single hold for Port Sudan caused certain problems regarding the cargo distribution. Finally, it was decided that holds No. 1, No. 2 and No. 4 would be used for the cargo destined for Mozambique, and that hold No. 3 would be used for the cargo for Port Sudan. With this loading plan, it was hoped that the stowage factor would be higher than anticipated in order to avoid having to strap the cargo surface of either hold No. 1 or hold No. 3. If strapping were required in either one of these holds, the charter party specified that the cost would be borne by the vessel. A stevedoring gang was retained on December 11 and stood by to carry out this work. As loading had been cancelled until deballasting problems were resolved, the gang's services were neither required nor utilized nor was the gang ever recalled to the "CHARLIE".

2. Damage and mechanical defects

On December 16 and 22, 1989, in the North Atlantic, while the "CHARLIE" was heading for Montreal, the supports of the derricks between holds No. 2 and No. 3 and the crutch of derrick No. 1 collapsed due to bad weather. The incident of December 22 occurred as, while derrick No. 1 was being made fast, a large wave suddenly submerged the starboard quarter

and damaged the superstructure near the officers' quarters; this latter damage went largely unrepaired and the vessel subsequently sailed on the return voyage in that condition.

While the "CHARLIE" was bound for Montreal, the following mechanical defects were reported:

a. main engine cooling problems;

b. oil leaks in several valves of the main engine;

c. a cracked cylinder liner in the main engine;

d. inadequate heating system on board;

e. propeller blades damaged by ice.

Upon arrival in Quebec, the master of the "CHARLIE" submitted two notes of protest concerning these events, one referring to the main engine and propeller damages, and the other to the superstructure damage, which stated in part:

THAT on December 22nd, 1989, while vessel was heaving to due to a violent storm, the cradle of the boom's rest No. 1 broke;

THAT in order to lash the boom properly, we altered course which brought seas on starboard quarter;

THAT following the aforesaid alteration of course, an exceptional high wave swamped the poop causing extensive damages including damages to the officer's messroom aft' steel wall and wall and ceiling linings;

THAT the aforesaid incident caused also damage to the galley where two windows and skylight broke, as well as damage to a wooden door and frames on the boat deck;

During the vessel's stay in Canada, repairs/service were carried out to the vessel's gyro-compass, radar, main radio transmitter, No. 2 derrick crutch, a servo-motor, the vessel's propeller and to the static converter of her diesel generator. No mechanical or other deficiency of consequence to navigation was noted or reported by the pilots during the vessel's outbound transit from Montreal to Les Escoumins.

3. Call at the Port of Quebec

The "CHARLIE" arrived in the Port of Quebec at about 1630 on January 4, 1990 for repairs, among other things, to her propeller and to her main engine. During these repairs which

were carried out under the general direction of the ship's managers shore based engineer superintendent, the fore peak tank, No. 1 and No. 2 port and starboard topside and double bottom ballast tanks were filled. This ballasting caused the vessel to trim by the bow and enabled repairs to be carried out to the emerged propeller blades. After the repairs were completed to the satisfaction of the classification society, (NK), the fresh water ballast in the fore peak tank was reduced to some 300 mt, the after ballast tanks were filled, and the Canadian Coast Guard authorized the "CHARLIE" to leave the Port of Quebec for Montreal, her loading port.

During her stay in the Port of Quebec, the holds of the "CHARLIE" were inspected by the Food Protection and Inspection Directorate inspector of Agriculture Canada. On January 6, the inspector issued a certificate stating that holds No. 1, No. 2, No. 3 and No. 4 were free of any material which could contaminate a cargo of grain.

At about 1030 on January 8, 1990, the "CHARLIE" left the Port of Quebec upbound towards Montreal, where she arrived the next day (January 9, 1990) at about 1330.

4. International Regulations for Loading Grain

The Flag State, Contracting Governments, and the master who has the ultimate responsibility for the loading and safety of his ship, are all responsible for ensuring that a ship loads grain cargoes in accordance with international regulations. These regulations are detailed in Part VI of SOLAS 1974, as amended. Cyprus has ratified this Convention and amendments.

Canada deposited an instrument of accession to the International Convention on the Safety of Life at Sea (SOLAS) 1974, with the Secretary-General of the International Maritime Organization on 8 May 1978. SOLAS (1974), as amended, entered into force on 25 May 1980.

Article I(b) of the Convention states:

(b) The Contracting Governments undertake to promulgate all laws, decrees, orders and regulations and to take all other steps which may be necessary to give the present Convention full and complete effect, so as to ensure that, from the point of view of safety of life, a ship is fit for the service for which it is intended.

These requirements are enacted in Canada by regulation made pursuant to Part VIII of the Canada Shipping Act (CSA) (Chapter S9 1985), the part governing Port Wardens; that part specifically excludes its application to the Ports of Montreal

and Quebec. CSA Regulations SOR/1979-852, SOR/1979-902 and SOR/1983-890 refer.

The regulations state in part:

> Application.... these Regulations apply to all ships loading grain consigned to any place that is outside Canada....

The function of a Port Warden is to examine the condition and stowage of cargo, in the interest of safety and commerce. In practice the Port Wardens appointed under the C.S.A. generally confine themselves to the loading of inherently dangerous cargoes, timber deck-cargo, grain, concentrates etc., and those in Montreal and Quebec City under their own Acts, fulfill a similar role.

The Office of the Port Warden at Montreal reports to the Board of Trade, and comprises a port warden and two deputy port wardens.

Section 14 of "The Acts Relating to Port Wardens at Montreal", as amended in 1882, generally governs the Montreal Port Wardens office. Rules and By-Laws of the Harbour of Montreal, as Sanctioned by the Council of the Board of Trade, govern the loading of grain in greater detail, but these were last amended in 1957. The requirements are based on the standards of that era; there is no provision for slack holds and securing, other than by bagged grain, for instance. There are no special requirements regarding stability, other than general provisions for the Port Warden to ensure a vessel is seaworthy.

The Office of the Port Warden of Montreal is specifically excluded from the provisions of Part VIII of the Canada Shipping Act, however, in practice the Office administers and applies all international and federal regulations regarding the loading of grain and other special cargoes.

Although there exists no formal agreement to do so, the procedures followed in this regard are similar to those carried out by Port Wardens designated by the Minister of Transport under Part VIII of the Canada Shipping Act.

5. Inspection of the "CHARLIE"

Generally, when a vessel loads grain in the port of Montreal, the Office of the Port Warden is advised of the expected date of arrival of the vessel; on arrival, she is inspected and a certificate of readiness to load is issued.

Generally, a port warden must complete a general inspection of the holds to verify that the wells are clean and dry before being covered with jute and cemented. He must also check the general condition of the holds and make sure that they are undamaged. Especially during the winter, the port warden should make sure that all liquid ballast not necessary for the voyage is discharged before the vessel's departure. In this case, the "CHARLIE" was inspected on the afternoon of January 9, 1990. The holds were found to be clean and dry, and the interior of the wells were inspected before being covered with jute and cemented. No damage was found inside the holds, and the general condition of the vessel was judged to be normal for a vessel of her age. The Booklet for Grain Loading was verified as being approved by the administration, and it included the permissible heeling moments for an angle of heel of 12°, that is, for the purposes of a standard Type 2 calculation of stability.

6. Certificate of Readiness to Load

Under certain circumstances, a cargo of grain that is not properly stowed can place a vessel in danger. Shifting of the grain can cause a major list or even cause the vessel to capsize.

According to the regulations, the master of a vessel which is preparing to load a cargo of grain must produce a calculation of stability on an approved form, indicating the worst possible condition for the vessel during the projected voyage. This calculation must be presented to the port warden for approval before the vessel can receive a certificate of readiness to load from the port warden.

In this case, the cargo which the "CHARLIE" was preparing to load was No. 3 CWRS (Canadian Western Red Spring) bulk wheat with a stowage factor estimated before loading, at 1.246 m^3/mt.

A pre-loading calculation of stability was accepted on January 9, 1990 by the deputy port warden, who then at 1530 issued a certificate of readiness to load a total cargo deadweight of 18,700 mt, having the following distribution:

- hold No. 1 - with an ullage of 1.75 m;
- holds No. 2 and No. 4 - holds and hatchways filled;
- hold No. 3 - with an ullage of 5.25 m.

The deputy port warden noted on the certificate, that depending on the actual stowage factor, the vessel might be required to strap one hold to comply with regulations.

7. **Loading Sequence**

Loading began during the afternoon of January 10, and after completing holds No. 2 and No. 4 at 2100 and at 2045 respectively, it was determined by those in charge of the loading that the stowage factor was 1.275 m^3/mt, compared to the figure of 1.246 m^3/mt used in the pre-loading calculation of stability. The loading process was observed from time to time by the deputy port warden, and between 0800 and 0830 on the morning of January 11, he inspected holds No. 2 and No. 4 before they were battened down. The surface of the grain in these two holds was reported to have reached the level of the hatch coamings. At the time of this visit, hold No. 1 was partially filled, with a ullage of 1.5 to 1.7 m., and loading of hold No. 3 was underway.

At about 0930 of January 11, 1990, the deputy port warden halted the loading operations because of a pronounced list to port and a trim by the head of 1 m. At this time, the vessel was having trouble deballasting the fore peak tank and double bottom tanks No. 1 and No. 2. The mean draught was verified and it was determined that some 17,650 mt of cargo had been loaded, and that a further 270 mt would bring the vessel to her winter marks. Consequently, in order to load a total of 18,500 mt of cargo and also additional oil fuel, more water ballast needed to be discharged. The deputy port warden verbally ordered the vessel not to resume loading.He then left the vessel and returned the next morning, January 12, 1990. On his arrival, it was determined that the "CHARLIE" was in the same condition as the night before, and on inquiry he was informed that the problem had been localized and that ballast was being pumped out. Before leaving the vessel, the deputy port warden again forbade further cargo loading until the deballasting problem was corrected.

The deputy port warden was then replaced by the port warden, who visited the "CHARLIE" for the first time during the evening of January 12, 1990. It was determined that the vessel still had a forward trim, and he was told that necessary measures had been taken to empty the fore peak tank and double bottom tanks No. 1 and No. 2.

The next day, January 13, 1990, the port warden returned to the vessel, and, as the forward trim had been reduced to 80 cm, he authorized the vessel to resume loading. At about

1300, loading recommenced. Reportedly a further 200 mt was loaded in hold No. 1, however the port log records 463mt as having been loaded at this time. At 1830, loading of hold No. 3 was completed. Deballasting of the No. 1 & No. 2 double bottom tanks with ship's pumps, and also the fore peak tank with a portable pump rented from a Montreal firm continued throughout this time.

Before closing and battening down holds No. 1 and No. 3, some 19 mt of baled empty grain bags and rolls of string were stowed in the empty space at the forward end of hatchway No. 1, and some 9 mt on the level unsecured surface of the grain in hold No. 3.

In anticipation of the satisfactory completion of loading and the resolution of the vessel's deballasting problems and as an administrative convenience, a Port Warden's Certificate was prepared and dated on Friday, January 12, 1990, the date on which Canada Customs issued and dated the vessel's Outward Clearance. At about 2130 on Saturday January 13, the port warden verbally authorized the vessel to proceed to sea, handed over the certificate and disembarked.

At about 2320, the "CHARLIE" left berth No. 54 for berth No. 103 to bunker fuel, all the while continuing to deballast. After taking on 250 mt of fuel and disembarking the portable pump, she let go from berth No. 103 and proceeded to sea at about 0700, January 14, 1990.

8. Grain Cargo Loading

Although as stated, the part of the CSA applicable to Port Wardens does not apply in the Port of Montreal, it is the policy of the Port Wardens there to conform to Coast Guard practices.

Prior to the commencement of cargo loading a standard form for the "Calculation of Stability for Vessels Loading Bulk Grain" (Type 2), was submitted by the master in accordance with the CCG "Instructions to Masters of Vessels Loading Grain in Canada", (TP 215), and accepted by the deputy port warden on January 9, 1990, as required by the CCG "Port Warden Instructions" (Grain), (TP 857).

The standard form showed the intended distribution of some 18,700 mt of grain cargo based on a stowage factor of 1.246m^3/mt, together with those consumables and trimming ballast expected to be remaining onboard on completion of cargo loading at the grain elevator wharf. The data as calculated and submitted by the master showed the total upsetting moments to be less than the maximum allowable total

given in the vessel's approved Grain Loading Booklet. Consequently the data as presented to the assistant port warden showed that the vessel met the minimum SOLAS 1974 and Canadian regulatory stability criteria. However, because different cargo and consumables deadweights were finally adopted, this data became redundant. A grain cargo deadweight of some 18,500mt was loaded instead of the 18,700mt previously indicated, and because the vessel discharged some fresh water ballast and took on additional bunkers after leaving the grain loading wharf, her stability characteristics on departure differed from those originally submitted. Subsequently, a corrected Type 2 stability form reflecting the actual cargo deadweight of 18,500 mt and the final consumables distribution was not submitted by the master for the approval of the port warden, as required by TP 215 and TP 857. Neither the port warden nor his deputy required that a new calculation be submitted.

The submitted Type 2 stability form incorporating grain cargo upsetting moments based on the hold end voids in the "filled" holds No. 2 & No. 4 being untrimmed, was accepted by the deputy port warden on presentation by the master of a document reportedly authorizing such dispensation.

In this regard, the Inter-governmental Maritime Consultative Organization (IMCO) - now the International Maritime Organization (IMO), published MSC/Circ 323 on April 7, 1982, which states in part:

DISPENSATION FROM TRIMMING ENDS OF HOLDS IN CERTAIN SHIPS

1. Regulation 3(a) of Chapter VI of the 1974 SOLAS Convention requires that bulk grain shall be trimmed so as to fill all spaces under the decks to the maximum extent possible. However, Regulation 3(c) permits the Administration issuing the document of authorization to grant dispensation from trimming in those cases where the underdeck void geometry is taken into account.

2. As a result of discussion within the Organization it has been agreed that dispensation may be granted from trimming the ends of holds in specially suitable ships, when requested, provided that an additional entry of heeling moments for "filled holds with untrimmed ends" is approved and included in the ship's grain loading stability booklet. It was further agreed that the untrimmed ends should be treated as "partly filled spaces" and that accordingly, the grain surface in these portions of the hold should be assumed to shift to an angle of 25° from the horizontal.

3. After taking into account the heeling moments due to the shift of grain in the untrimmed ends, dispensation may be granted provided the ship meets the stability criteria required by Regulation 4 or Section V(B), as appropriate, of Chapter VI of the 1974 SOLAS Convention.

4. This dispensation may be granted only to ships which are arranged with sloping bulkheads, port and starboard, forming the longitudinal inner boundaries of upper wing tanks and which slope at an angle of 30 degrees or more to the horizontal.

The "CHARLIE" was constructed and arranged in such a manner as to comply with the requirements of paragraph 4, however neither her "Certificate of Approval of Ship's Plans For the Carriage of Bulk Grain", No. 86CG-116, nor her "Booklet for Grain Loading", No. H46669, approved pursuant to Chapter VI SOLAS 1974, on September 18, 1986, by Nippon Kaiji Kyokai (NK), under the authority of the Government of the Republic of Cyprus, incorporate any reference to the dispensation indicated in paragraphs 1, 2 & 3 of MSC/Circ 323.
Furthermore, reviews of NK and the flag state vessel's records do not show any record of any dispensation/approval regarding the carriage of bulk grain in holds having untrimmed ends.

Volumetric heeling moments for filled holds with trimmed ends are listed in the vessel's approved Grain Loading Booklet, which also contains ullage/transverse heeling moment curves for each of the holds when partially full. These heeling moment curves are increased by 12% in accordance with regulatory requirements, and are for application to holds which are only partially filled and in which the free grain surface has been levelled.

The heeling moments for holds No. 2 and No. 4 included in the Type 2 stability form submitted by the master were greater than those listed for filled holds with trimmed ends, and coincided with the moments related to the near zero ullage levels for partially filled holds with levelled grain surfaces. However, because holds No. 2 and No. 4 were "filled" but had untrimmed ends, application of the heeling moment curves was inappropriate, and post-casualty calculations show that the heeling moments for the untrimmed ends loading configurations in the holds exceeded those included in the submitted Type 2 stability form.

IMO (SOLAS 1974), Chapter VI, Carriage of Grain, Part A - General Provisions, states in part:

Regulation 2

Definitions

(b) The term "filled compartment" refers to any compartment in which, after loading and trimming as required under regulation 3, the bulk grain is at its highest possible level.

(c) The term "partly filled compartment" refers to any compartment wherein bulk grain is not loaded in the manner prescribed in paragraph (b) of this regulation.

Regulation 3

Trimming of grain

All necessary and reasonable trimming shall be performed to level all free grain surfaces and to minimize the effect of grain shifting.

(a) In any filled compartment, the bulk grain shall be trimmed so as to fill all spaces under the decks and hatch covers to the maximum extent possible.

(b) After loading, all free grain surfaces in partly filled compartments shall be level.

(**Note:** Underlining is for emphasis in this particular instance).

Analysis of the Port Log/ Statement of Facts loading figure of 4,263 mt, in conjunction with the known 100% volume of hold No. 1, shows the stowage factor of 1.275m^3/mt, accepted while loading was actually in progress, to be a "nominal" figure. The originally selected stowage factor of 1.246m^3/mt in conjunction with the recorded deadweight of 4,263 mt equates to some 97% of the total hold volume and more accurately reflects the actual loading condition, as it allows (in part), for the hold end voids and bales of empty grain bags known to have been present and which, in total, slightly exceeded this deduced 3% difference in volume. Consequently post-casualty stability analysis is based on the original stowage factor.

The cargo distribution reportedly adopted in hold No. 1 was such that after loading the last of the bulk grain on January 13, the hold ends were untrimmed, the after half of the hatchway was nearly filled, and the grain surface in the forward half was unlevelled and sloped downward toward the bottom of the hatch's forward coaming. Just prior to securing the hatch covers, 158 bales of empty grain bags each measuring approximately 0.9m x 0.46m x 0.46m, together with 15 bundles of twine were placed directly on top of the sloping and unsecured grain surface. Calculations show the total stowed volume of the bales to be some 35m^3, which is less than the

volume of the wedge shaped void reportedly formed by the forward sloping face of the bulk grain within the hatchway.

Conflicting post-casualty information indicates that the bulk grain surface was levelled throughout the area of the hatchway before the baled empty grain bags were stowed. However, the ullage related to the total bulk grain reportedly loaded is some 0.7m below the top of the hatch coamings, and the maximum area covered by all of the bales of empty grain bags arranged in one layer is approximately 70m^2, which is only 32% of the total area within the hatchway.

While a definitive configuration of the final level and distribution of bulk grain cargo in hatch N°1 cannot be determined, review of the conflicting post-casualty information indicates the presence of some voids and unsecured grain surfaces in both instances, and that in either case, hold N°1 was not completely "filled".

Based on the stowage factor of 1.246m^3/mt, review of the recorded deadweights of 5,489 mt and 5,248 mt in holds No. 2 & No. 4, shows that the cargo in each hold occupied some 98% of the hold's total volume, thus once again allowing (in part) for the voids known to exist at their untrimmed ends and more accurately reflecting the actual loading condition on departure.

Hold No. 3 was loaded to approximately 62% of its total volume with some 3,500 mt of grain, the surface of which was generally levelled, and some 9 mt of baled empty grain bags were placed directly on the unsecured surface. In this regard, the maximum area covered by the 72 bales of empty grain bags and 7 bundles of twine arranged in one layer is some 32m^2.

The originally proposed cargo loading distribution was such that holds No. 1 & No. 3 were to be partially filled, consequently the ship's managers contacted the Cypriot authorities for approval of the utilisation of wire reinforcement mesh in securing the slack grain surface in at least one of the partially filled holds, in order to comply with regulatory stability and grain securing requirements. Such permission was forwarded by the Cypriot authorities and CCG were also advised by telex on January 10, 1990. Subsequently, when the actual cargo deadweight and distribution were changed and a higher stowage factor accepted, those in charge of the loading regarded hold No. 1 as being "filled", thus eliminating the need for any surface securing, and as only one hold, (No. 3) then remained slack as indicated in the vessel's approved Booklet for Grain Loading, its surface was left unsecured.

In summary, the cargo distribution on departure was such that the ends of the "filled" holds No. 2 & No. 4 were untrimmed, as were the ends of the less than completely full hold No.1. There is no reference to or details of pre-calculated allowable upsetting moments for untrimmed hold ends in the vessel's NK approved grain loading authorization document (86CG-116), or Grain Loading Booklet (H46669).

9. Stability

Approval of the vessel's intact transverse stability for the carriage of bulk grain cargoes pursuant to the requirements of Chapter VI of SOLAS 1974, was given in the document of authorization (86CG-116) and Booklet for Grain Loading (H46669), both of which were issued and approved on September 18, 1986 by NK under the authority of the Government of the Republic of Cyprus.

The document of authorization referred to instructions included in the vessel's approved Booklet of Grain Loading, which, in turn incorporated extracts from the regulatory stability requirements for the guidance of the master, and stated in part:

Regulation 3

Trimming of Grain

All necessary and reasonable trimming shall be performed to level all free grain surfaces and to minimize the effect of grain shifting.

(a) In any "filled compartment", the bulk grain shall be trimmed so as to fill all the spaces under the decks and hatch covers to the maximum extent possible.

(b) After loading, all free grain surfaces in "partly filled compartments" shall be level.

(c) The Administration issuing the document of authorization may, under Regulation 9, grant dispensation from trimming in those cases where the underdeck void geometry resulting from free flowing grain into a compartment ..... is taken into account to its satisfaction when calculating the void depths.

Regulation 4

Intact Stability Requirements

(b) The intact stability characteristics of any ship carrying bulk grain shall be shown to meet, throughout the voyage, at least the following criteria after taking into account in the manner described in Part B, the heeling moments due to grain shift:

(i) the angle of heel due to the shift of grain shall be not greater than 12 degrees .....

(ii) in the statistical stability diagram, the net or residual area between the heeling arm curve and the righting arm curve up to the angle of heel of maximum difference between the ordinates of the two curves, or 40 degrees or the "angle of flooding" (θ_f), whichever is the least, shall in all conditions of loading be not less than 0.075 metre-radians; and

(iii) the initial metacentric height, after correction for the free surface effects of liquids in tanks, shall be not less than 0.30 metre.

(c) Before loading bulk grain the master shall, if so required by the Contracting Government of the country of the port of loading, demonstrate the ability of the ship at all stages of any voyage to comply with the stability criteria required by paragraph (b) of this Regulation .....

Regulation 9

Application of Parts B and C

An Administration or a Contracting Government on behalf of an Administration may authorize departure from the assumptions contained in Parts B and C in those cases where it considers this to be justified having regard to the provisions for loading or the structural arrangements, provided the stability criteria in Regulation 4(b) are met. Where such authorization is granted under this Regulation, particulars shall be included in the document of authorization or grain loading data.

(**Note:** Underlining is for emphasis in this particular instance).

With regard to the requirements of Regulations 3 and 9, neither the document of authorization (86CG-116) or the booklet No. H46669 included any reference to or approval of a dispensation for untrimmed ends of cargo holds, consequently

the manner in which the proposed cargo loading stability form (Type 2) was prepared is considered to have been invalid. Furthermore, the cargo, consumables and water ballast incorporated in the submitted form did not represent the final intended voyage departure loading condition.

Due to the problems reportedly experienced while attempting to discharge fresh water ballast during and after completion of grain cargo loading and also while bunkering, details of the distribution and quantity of frozen and other unpumpable fresh water ballast onboard on departure can only be estimated. However, comparison of the summation of the vessel's lightship weight, reported cargo deadweight, consumables and deduced unpumpable and frozen fresh water ballast, with the displacement derived from the recorded fresh water departure draughts, showed an insignificant (3 mt) difference. Consequently, the deduced weights allowed for the unpumpable and frozen ballast are considered to be "the best possible estimate" for incorporation in post-casualty stability calculations. Furthermore, analysis of the recorded departure draughts shows that after due allowances for hull hog, head trim and fresh water density, the "CHARLIE" was loaded to a mean draught such, that after leaving the fresh water of the St. Lawrence River and on entering the Gulf of St. Lawrence, her mean salt water draught complied with her assigned Winter Load Line of 9.341 m.

Post-casualty stability analysis focused on the effects of the grain cargo stowage and distribution reportedly adopted on departure, with particular regard to compliance with the stability requirements of SOLAS 1974, Chapter VI, Reg 4.

The Type 2 proposed stability form presented by the master showed the ends of holds N°2 and N°4 were to be untrimmed and as a mechanical trimmer was not employed throughout the loading operation it may be deduced that the ends of the less than completely filled hold N°1 were similar.

The ends of holds No. 1, No. 2 & No. 4 were untrimmed and no data regarding the related upsetting (heeling) moments was included in the vessel's approved Booklet for Grain Loading. Consequently, for comparison with regulatory requirements and analysis purposes, the relevant upsetting moments for each of the untrimmed holds ends were calculated in accordance with IMCO MSC/Circ 323, and used in conjunction with the best estimated departure loading condition to establish the vessel's most likely transverse stability characteristics.

Revision of the CCG standard stability form (Type 2), shows that on departure the sum of the calculated upsetting moments due to shifting grain as prescribed by the regulations was virtually equal to the related maximum allowable upsetting

moment derived from the vessel's approved grain loading data. Further calculations show that after due allowances for fresh water and oil fuel consumption, and in the absence of any compensatory ballasting, the vessel's centre of gravity would gradually rise during the projected voyage. The subsequent reduction of transverse stability characteristics would have been such that at the estimated time of her loss, and on arrival after a voyage of some 11 days, the approximate angles of heel due to the regulatory prescribed shift of grain cargo would have been 12.75° and 13° respectively, - both slightly exceeding the regulatory allowable maximum of 12°.

SOLAS 1974 requires that compliance with the regulatory stability criteria be maintained throughout any projected voyage, and the CCG standard form (Type 2) together with TP 857 and TP 215 also call for the submission of the worst stability condition likely to be experienced during a voyage. In this regard, post casualty calculations reflecting a voyage exclusively in salt water show the vessel's arrival condition to have inferior transverse stability characteristics to those on departure. However, the vessel initially sailed in fresh water, and while in the St. Lawrence River her statical stability was such that, her angle of heel in response to the regulatory prescribed shift of cargo would have marginally exceeded the allowable maximum 12°.

While the vessel's statical stability characteristics were insufficient to restrict her heeling to less than 12° after the regulatory prescribed shift of cargo, calculations show that on departure and also at the estimated time of her loss, her initial transverse stability was relatively high, in that her transverse metacentric height (GMf), was slightly more than 2.4 m, and was approximately eight times greater than the regulatory minimum of 0.3 m. It should be noted that the regulatory criteria represent minimum requirements with no upper limits having been set, and such a high GMf would result in the vessel's initial transverse stability being very positive and "stiff".

Such "stiffness" produces a relatively short natural rolling period which, in conjunction with the rolling motions imparted by heavy beam seas, can cause vertical accelerations conducive to a marked settling of bulk grain and athwartship movement of the subsequently created voids' loose and unsecured surfaces.

The resultant statical heeling moment in conjunction with the dynamic heeling effects of heavy beam sea induced rolling motions can also cause a sudden shift of unsecured grain cargo. These combined statical and dynamic heeling and rolling effects can be such, that a vessel's ability to recover is significantly reduced and retarded. While in this

condition she is more vulnerable to weather damage and subsequent downflooding from shipped seas, which simultaneously reduce freeboard and reserve buoyancy, and can also quickly eliminate transverse stability.

In summary, while no precise cause for the vessel's disappearance has been conclusively established, the absence of any record of emergency or MAYDAY radio broadcasts would appear to indicate that her loss was sudden and unforeseen.

10. Photographic record of grain loading

Several photographs were taken on behalf of the Canadian International Development Agency, (CIDA), recording the condition of all the cargo holds prior to the start of loading, which show the holds to have been clean and suitably prepared for the reception of the bulk grain cargo. A less complete record was made of the loading operation, and only two photographs are known to have been taken during and on completion of loading in holds N°1 and N°4. Coloured photographic prints have been located, however negatives for any of the prints have not been traced at the time of completion of this report.

The photographs taken during and on completion of loading in way of hatches N°1 and N°4 show only parts of the bulk grain surfaces, and in both instances the prints are flawed due to extraneous light infiltration of the original negatives. For analysis purposes each of these prints was laser scanned on a cross field scanner, and a four colour separation made in order to correct colour and enhance detail.

Review of the enhanced photograph of hatch N°1 shows the bulk grain to be generally level throughout the middle one third of its length, with a mean surface just below the level of the bottom of the hatch side girder. The grain surface in the after third of the hatchway slopes downward toward the after end of the hold, and is clearly below the bottom of the hatch end beam. Due to the angle from which the photograph was taken the forward end of the hatch cannot be seen, however, the hatch appears to have been loaded symmetrically and the foremost grain surface to slope downward toward the forward end of the hold.

Cargo loading records included in the Port Log/Statement of Facts show 3,800 mt of grain to have been loaded in hold N°1 by 2200, January 10, and that no more cargo was loaded in that hold until loading was resumed January 13, when a further 463mt was recorded as having been loaded in two runs from 1300 to 1310, and from 1500 to 1515.

At about 0930, January 11, when the deputy port warden halted all loading operations, the ullage in hatch N°1 was estimated to be approximately 1.5m to 1.7m. Ship's plans show the combined hatch coaming and side girder to be 1.4m deep and so it may be deduced that the ullage in way of the generally level area of grain at the mid length of the hatch was some 1.6m, thus confirming the estimates made from the photograph and the onboard observation.

From examination of the enhanced photograph it is estimated that after due allowances for the unfilled volumes remaining in way of the hatchway and in the hold end voids below the main deck, the mean surface level of all of the grain loaded at the time the photograph was taken, was markedly below the bottom of the hatch side girders. This level is consistent with an ullage of 2.375m derived from the vessel's Grain Loading Booklet for a levelled cargo of 3,800mt @ 1.246m^3/mt, and therefore it is considered that the photograph was taken some time before resumption of loading at 1300 January 13. At an ullage of 2.375m, some 725m^3 of hold volume remain unfilled and because the combined volumes of the 463mt of bulk grain and 158 bales of empty grain bags loaded after 1300, January 13, amounted to only 610m^3, then voids of approximately 115m^3 remained on completion of loading.

In view of the conflicting information on the actual level and surface configuration of grain in the hatchway, and since hold end voids are known to have been present because the mechanical hold end trimmer was not employed, hold N°1 cannot be considered to have been completely "filled".

Review of the enhanced photograph of hatch N°4 shows the uneven bulk grain surface to be peaked near the centre of the hatchway, and that the apex of the peak is slightly higher than the coaming top level. Hand trimming shown to be in progress, was reportedly carried out by a crew member to ensure clearance for the pontoon hatch covers prior to their installation.

Cargo loading records included in the Port Log/Statement of Facts show holds N°2 and N°4 were loaded virtually simultaneously on January 10th, 1990, that each was completed after two continuous runs of grain from the elevator, and that the second runs continued for 2h-15min and 2h-45min respectively. As no short "topping-up" grain runs were recorded for either of these hatches, it may be deduced that no further grain was added to hatch N°4 after the photograph was taken.

From further examination of the uneven bulk grain surface revealed by the enhanced photograph, it is estimated that the unfilled volume in the hatchway corners and sides exceeded

that of the peak remaining to be trimmed, and that consequently on completion of hand trimming the hatchway volume below the pontoon covers would not be completely filled. Because the entire hatchway is not shown in the enhanced photograph the volume remaining unfilled on completion of hand trimming cannot be precisely calculated. However, for post-casualty loading and stability analysis purposes, only heeling moments similar to those shown in the vessel's approved Grain Loading Booklet for levelled grain surfaces were incorporated, to conservatively represent the actual grain surface conditions in hatches N°2 and N°4 on departure.

11. Longitudinal Structural Strength

Based on the derived departure loading distribution and the still water bending moment (SWBM) criteria detailed in the vessel's Loading Manual, Drawing No. 752942, calculations confirm that the vessel was in the slightly hogged condition indicated by the draughts recorded on departure, and that the bending moment acting near midships was approximately 29,294 tonne metres, which was only 58.5% of the maximum permissible moment.

In May 1988, at Perama, Greece, the principal structural components within the midship body of the vessel were the subject of ultra-sonic thickness measurement examination as part of her classification special survey requirements. At that time, the survey results were satisfactory, with all the percentage thickness wastage within accepted limits. Consequently, subject to the absence of a recent marked acceleration in plate thickness wastage or newly incurred localised hull girder damage, the possibility that sudden and catastrophic structural failure may have been the cause of the vessel's loss is considered unlikely.

12. Concern of the master

While the "CHARLIE" was in Canadian waters heading for the open sea, the master in general conversation with a pilot, expressed concern regarding the difficulties encountered while the vessel was loading in Montreal, but he was not specific in his remarks except for reference to the vessel's forward trim. However, the master had signed the final cargo stowage plan which indicated the vessel was trimmed by the head on departure. This plan also showed hold No.2 and hold No.4 to be "Full", hold No.3 to be "Slack", while the final condition of hold No.1 was not stated.

13. Hatch Closing Arrangements

The vessel was fitted with four hatchways, each serving one hold. The closing arrangements noted on departure, with the pontoons in place, were seen to be covered with two layers of tarpaulins, secured with battens, wedges and locking bars. Nets were placed overall, and secured.

14. Departure Draught

The departure draughts used in the stability analysis of this report are as declared by the master on the vessel leaving the oil bunkering wharf. These draughts were accepted by the pilots during the passage down the River St. Lawrence but not verified by them because of difficulty reading the vessel's draught marks directly due to ice, etc.

15. Air Temperatures Recorded

From January 1 to January 14, 1990 the average maximum and minimum air temperatures, as recorded at Quebec Airport, were -3.4 degrees C and -11.2 degrees C, while the maximum and minimum air temperatures recorded were +3 degrees C and -22.1 degrees C, respectively.

During the same period the average maximum and minimum air temperatures as recorded at Montreal (Dorval) Airport were +3.3 degrees C and -10.4 degrees C, while the maximum and minimum air temperatures recorded were +4.5 degrees and -23.7 degrees C respectively.

These temperatures are consistent with those at which fresh water in exposed ballast tanks will freeze.

16. Alert and Search

At 1530 U.T.C. on January 24, 1990, the Coast Guard radio station at Dartmouth, Nova Scotia received a request from Transmed Shipping Ltd. Attiki, Greece, seeking assistance in locating the Cypriot vessel "CHARLIE". The owners were anxious because her scheduled communications had been interrupted. The last scheduled communication had been at 2221 U.T.C. on January 18, 1990 via Norddeich radio. This request for help in finding the "CHARLIE" and establishing communications with her was also addressed to the USCG in New York and to the Portuguese Coast Guard in Lisbon.

Officially, the "CHARLIE" was considered overdue on January 25, 1990 when she failed to arrive at Ceuta, Spain for refuelling as planned.

A search of the North Atlantic by the Canadian Coast Guard began early in the morning of January 27, 1990 and lasted 4 days, ending on January 30, 1990. Aircraft from the United States Navy, the Portuguese Air Force, Canadian Armed Forces and the Royal Air Force participated in the search. Throughout this period, the search was hindered by poor sea and visibility conditions.

After it was known that the "CHARLIE" had disappeared, it was determined that the general area in which the vessel was last known to be was within the coverage of a satellite capable of detecting a floating vessel of her size.

When recourse was made to this source of information at a later date, it was found that satellite imagery for the area of interest had not been recorded at the downlink (terrestrial) site as information from this part of the Atlantic Ocean was not required by the satellite's clients.

It is thus unknown if the "CHARLIE" was detected by the satellite.

Findings

The Cypriot vessel "CHARLIE" went missing with her master and crew of 26 in the Eastern Atlantic sometime after 0210 UTC January 20, 1990, and is presumed to have sunk. This inquiry was limited to events affecting the vessel while in Canada, however, it would appear that as no emergency radio broadcast was received from the vessel, her loss was sudden and unforeseen. These findings relate to her loading and to her departure condition on sailing from Montreal, PQ on January 14, 1990:

- The pre-loading bulk grain cargo stability data standard form submitted by the master and accepted by the Montreal Port Warden's Office became redundant due to subsequent changes in the cargo and consumables deadweights, and no revised data was prepared reflecting the vessel's actual departure loading or worst stability characteristics expected during the planned voyage.

- The forward and after ends of holds No. 1, No. 2 & No. 4 were untrimmed but there was no notice of such dispensation in the vessel's approved grain cargo loading booklet, and no record of a document presented by the master and sighted by the Port

Warden's office reportedly giving such dispensation has been found in NK or the flag state's records.

- Post-casualty calculations indicate that in the absence of any compensatory ballasting prior to her loss or throughout a planned voyage of 11 days, the angles of heel due to the regulatory prescribed shift of grain cargo would have been approximately 12.75° and 13° respectively, - both exceeding the regulatory allowable maximum of 12°.

- Fully loaded conditions included in the vessel's approved grain loading booklet for the guidance of the master, incorporate only one partially filled hold with a slack and levelled grain surface, and so obviate the regulatory requirement for securing that one hold surface with approved strapping. The bulk grain cargo distribution on departure was such that hold No. 3 was partially filled, the slack grain surface of which was levelled and unsecured, while the precise level and condition of the grain surface in the less than completely full hold No. 1 cannot be determined.

- The vessel's metacentric height (GMf) on departure was approximately eight times the regulatory minimum, resulting in a relatively short natural rolling period which could, in certain sea states, cause a violent rolling motion conducive to cargo settling and subsequent shifting of unsecured bulk grain surfaces.

- Calculations based on the reported loading distribution confirm the recorded draughts showing the vessel was trimmed 0.2m by the bow on departure, that the hull was slightly hogged, and that the maximum still water bending moment was approximately 58.5% of the permissible bending moment indicated in her approved loading manual.

- A Port Warden's Certificate, which was issued to the vessel by the Office of the Port Warden as required by the Rules and By-Laws of that Office, was dated Friday January 12, 1990, the day before the vessel completed loading grain and before the problem of discharging frozen ballast had been resolved. It was reported however, that this certificate was prepared in advance as an administrative convenience.

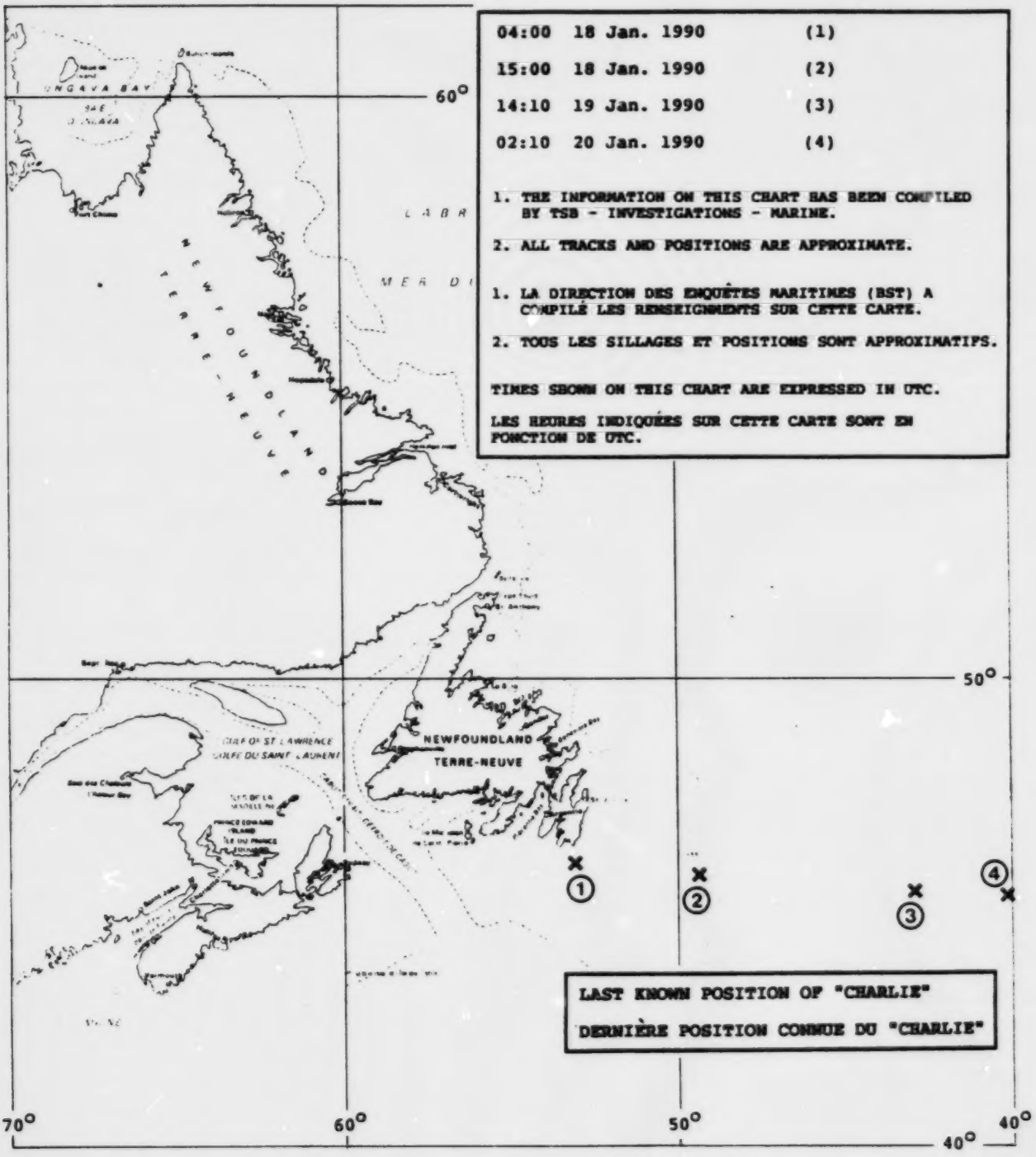
- The vessel sailed with some fresh water ballast which was umpumpable because of freezing.

- The Government of Canada has acceded to SOLAS 1974 Grain Rules with amendments, and advised IMO accordingly, by instituting the Grain Cargo Regulations and amendments made pursuant to the Canada Shipping Act. Montreal grain loading is not governed by the Canada Shipping Act but by the Acts Relating

to the Office of Port Warden for the Harbour of Montreal of 1882, and by the Rules and By-Laws 1957.

- The Acts Relating to the Office of Port Warden for the Harbour of Montreal 1882, and the Rules and By-Laws 1957, do not conform to the latest SOLAS grain loading requirements, however, in practice, the Office administers and applies all international and federal regulations regarding the loading of grain and other special cargoes.

- The master noted protest at the Port of Quebec inbound concerning heavy-weather damage to the vessel's accommodation which had occurred on her Westbound voyage. The damage was not repaired for her return Eastbound voyage towards Ceuta, Spain.


04:00 18 Jan. 1990 (1)
15:00 18 Jan. 1990 (2)
14:10 19 Jan. 1990 (3)
02:10 20 Jan. 1990 (4)
1. THE INFORMATION ON THIS CHART HAS BEEN COMPILED BY TSB - INVESTIGATIONS - MARINE.
2. ALL TRACKS AND POSITIONS ARE APPROXIMATE.
1. LA DIRECTION DES ENQUÊTES MARITIMES (BST) A COMPILÉ LES RENSEIGNEMENTS SUR CETTE CARTE.
2. TOUS LES SILLAGES ET POSITIONS SONT APPROXIMATIFS.
TIMES SHOWN ON THIS CHART ARE EXPRESSED IN UTC.
LES HEURES INDIQUÉES SUR CETTE CARTE SONT EN FONCTION DE UTC.
60°
50°
40°
70°
60°
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NEWFOUNDLAND
TERRE-NEUVE
GULF OF ST LAWRENCE
GOLFE DU SAINT LAURENT
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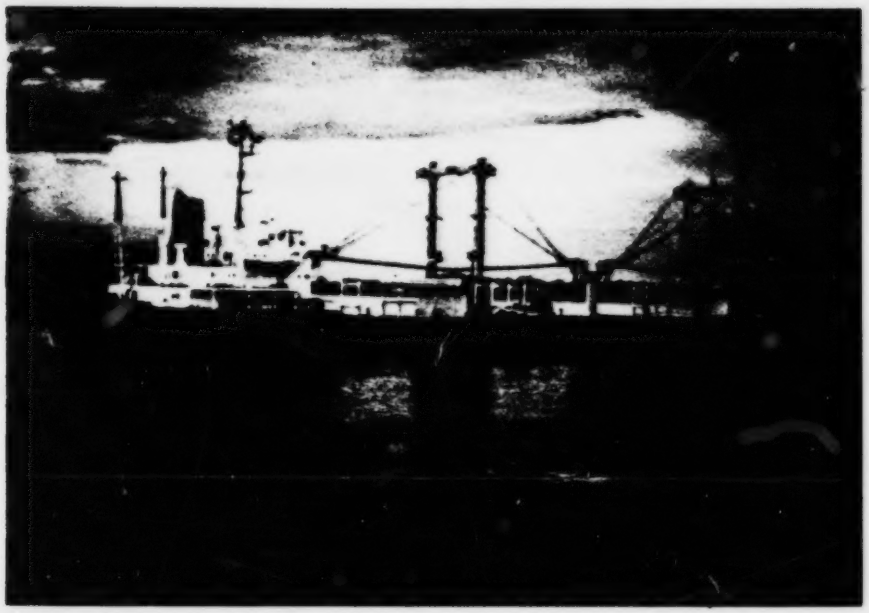
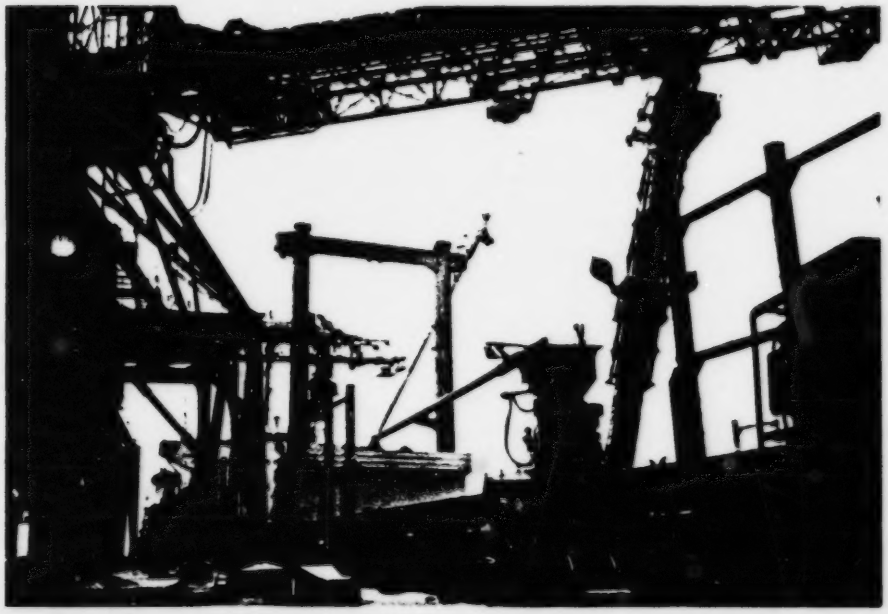
LAST KNOWN POSITION OF "CHARLIE"
DERNIÈRE POSITION CONNUE DU "CHARLIE"



"CHARLIE" in the River St. Lawrence, August 1988.
"CHARLIE" sur la Fleuve St. Laurent en Août 1988.



"CHARLIE" made fast at Montreal grain elevator No.4 January 1990.

"CHARLIE" amarré à l'élévateur No.4 dans le port de Montréal en Janvier 1990.